

You should work on the following assignments in fixed teams of two. Please note that *every* team member must be able to explain all solutions of the team of two. Please submit only one solution for each team of two.

**Deadline to upload your solution for at least assignments 1, 2.1, 2.2., and 2.3:  
Three days bevor the laboratory**

Assignment 2.4 can be done during the laboratory.

If you have questions or if you need any help, use the forum in our moodle room und help each other.

### Assignment 1: Kruskal's algorithm for calculating the minimal spanning tree

In the lecture we talked about Kruskal's algorithm and how it is applied to a graph to calculate the minimum spanning tree. However, we did not talk about the implementation in the lecture. There are several ways to implement this algorithm. I would like to show and discuss one of them in this assignment.

On the website

<https://www.programmingalgorithms.com/algorithm/kruskal's-algorithm/c/>

I found a complete C implementation of Kruskal's algorithm to calculate the minimum spanning tree. I have also attached the program as a .c-file in EMIL.

In your professional life you will always receive programs from other programmers, which you have to understand and if necessary, also to adapt and to extend. So, it is necessary to exercise the understanding of these programs. Understanding Kruskal's algorithm as well as reviewing the given program are the goals of this assignment.

#### 1.1 Understanding the program

Execute the program and try to understand how it works including the control flow, the data structures (i.e., Edge, Graph, Subset) and the variables. Use a debugger or pen and paper for this. Draw at least three intermediate steps of the program run and include them in your lab report. These intermediate steps should show the contents of the data structures graph, subsets including the value for rank, and result.

#### 1.2 Understanding the program

Draw the graph created in the main function. Also draw the minimum spanning tree which is calculated by the given program.

#### 1.3 Program evaluation

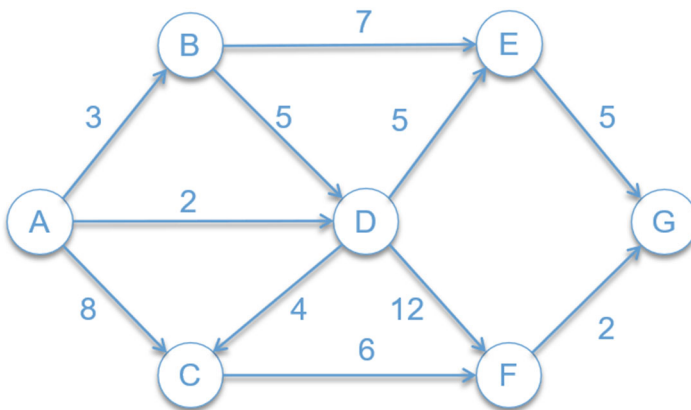
What do you like about the program? What do you find bad? Make at least 3 suggestions for improvements.

1.4 Line 75

From my point of view, line 75 is not correct. What do you think bothers me about this line? How would you rewrite this line?

Assignment 2 Graphs

Given is the following graph:



Assume vertex with smaller label is visited first.

Assignment 2.1 Representation

- How does the adjacency list for this graph look like?
- How does the adjacency matrix for this graph look like?

Draw the results and include the two different representations in your report.

Assignment 2.2 dfs and bfs

Start with A as root node.

- What is the order of vertex visits with depth-first search?
- What is the order of vertex visits with breadth-first search?

Assignment 2.3 Shortest path

Calculate the shortest path for the given graph with start node A and destination node G:

- Apply Dijkstra's algorithm to calculate the shortest path.
- Apply Bellman-Ford algorithm to calculate the shortest path.

Compare the results. Explain the reasons if the results are not equal.

Assignment 2.4 Minimum spanning tree

Calculate the minimum spanning tree for the given graph:

- Apply Kruskal's algorithm to determine the minimum spanning tree
- Apply Prim's algorithm to determine the minimum spanning tree

Compare the results. Explain the reasons if the results are not equal.